Original Report

Foodborne disease in our global village: a multinational investigation of an outbreak of *Salmonella* serotype Enteritidis phage type 4 infection in Puerto Vallarta, Mexico

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Objectives: In late 1996, a multinational investigation was launched following an outbreak of diarrheal illness that caused the disruption of an international scientific conference at a first-class hotel in Puerto Vallarta, Mexico.

Methods: A questionnaire was mailed to all American and to selected international attendees. Additional copies of the questionnaire were provided for any family members who may have attended the conference. A case was defined as an illness with three or more loose stools during a 24-h period in a conference attendee or accompanying family member, with illness lasting 2 or more days and onset between 6 and 9 November 1996.

Results: Questionnaires were returned by 81% (232/288) of American attendees, 47% (18/38) of selected international attendees, and 25 family members; 30% (83/275) of respondents met the case definition. Ill persons resided in at least seven countries. *Salmonella* serotype Enteritidis phage type 4 was isolated from stool specimens from patients residing in Canada, the UK, and the USA. Attending a hotel banquet on 6 November was associated with illness; 42% (82/194) of banquet attendees became ill versus 3% (1/37) of non-attendees (relative risk (RR)=15.6, 95% confidence interval (CI)=2.3–108.9). The only banquet food item associated with illness was chili rellenos; 53% (58/109) of persons who ate chili rellenos were ill versus 22% (12/55) of those who did not (RR=2.4, 95% CI=1.4–4.1). Chili rellenos ingredients included shelled eggs and cheese; *Salmonella* was isolated from the leftover cheese but the isolate was not serotyped.

Conclusions: *Salmonella* may be a cause of traveler's diarrhea and can result in outbreaks even among travelers who follow routine precautions (i.e. staying in a first-class hotel and eating hot foods). International collaboration in investigating similar outbreaks, including sharing subtyping results, will be necessary for long-term prevention. Global Salm-Surv, an international network of *Salmonella* reference laboratories coordinated by the World Health Organization, may facilitate such collaboration.

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INTRODUCTION

Many travelers experience acute gastroenteritis, also known as travelers' diarrhea, during journeys to international destinations. Although this illness usually resolves spontaneously, it may interfere with a carefully planned expedition. Most episodes of travelers' diarrhea are thought to have an infectious etiology. Enterotoxigenic *Escherichia coli* (ETEC) infections cause the majority of diarrheal illnesses in persons traveling to countries where sanitary conditions are poor.[1] *Salmonella* species, *Campylobacter jejuni*, rotavirus, enteric adenoviruses and many other pathogens are also common etiologies of travelers' diarrhea.

With more than one million people traversing international boundaries daily, and with the globalization of food production, manufacturing, and marketing, the risk of importing and exporting the agents of infectious diarrhea is substantial.[2,3] Few reports have investigated the prevalence of traveler's diarrhea. A study in Jamaica during 1996 of 30 369 short-stay visitors with mean durations of stay of 4–7 days estimated the incidence of travelers' diarrhea to be 21%, with symptoms lasting a mean duration of 12 h.[4] The incidence rate varied with geographic location, duration of stay, type of resort, previous travel to tropical countries, and season of travel. The major risk factor for travelers' diarrhea is the consumption

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behavior of the traveler; 'Cook it, boil it, peel it—or forget it' is well-known routine travel advice that has proven valuable. The incidence of traveler's diarrhea among persons staying in a first-class hotel would be expected, therefore, to be lower. Nevertheless, illness may still occur in persons who follow routine precautions.

Identifying outbreaks of infectious diseases in resort settings among short-stay travelers is a challenge, as these persons often leave ill and seek medical care at home. The outbreak of pneumonia involving delegates to the 1976 American Legion convention at a Philadelphia hotel may be the most publicized example.[5] Other outbreaks of Legionnaires' disease,[6,7] sandfly fever,[8] *Rickettsia africae* infections[9] and *Shigella sonnei*[10] infections among groups of travelers have been reported. Unless an organization coordinates the travel and provides follow-up, individual reports of illness among travelers will usually remain scattered, and the relationship among cases may be overlooked with propagation of the outbreak. We report an investigation of an outbreak of diarrheal illness among attendees of an international scientific conference in Puerto Vallarta, Mexico, who followed routine precautions. The investigation of this outbreak resulted in a multinational collaborative effort.

METHODS

Background

On 15 November 1996, the Foodborne and Diarrheal Diseases Branch of the Centers for Disease Control and Prevention (CDC) was notified of several cases of diarrheal illness among attendees of the annual conference of American Association of Zoo Veterinarians in Puerto Vallarta, Mexico. Conference organizers reported that the illness disrupted the conference, since illness occurred in both conference attendees and program presenters. Conference organizers provided a detailed schedule of events and a list of the 454 conference participants. All attendees stayed at a single 'first-class' hotel in Mexico. Hypothesis-generating interviews with seven participants who experienced diarrheal illness indicated that the 6 November banquet was the likely source of the outbreak. No other common exposures were reported; the participants did not visit animal facilities or report animal contact. We therefore focused on the 6 November banquet; a full list of food items and ingredients served at that banquet was reviewed with the participants.

Epidemiologic investigation

Self-administered questionnaires were mailed to all conference attendees living in the USA and to a limited number of international attendees. Respondents were asked to identify their date of arrival in Mexico and whether they experienced symptoms of a diarrheal illness, which was defined as three or more loose stools during a 24-h period. If diarrheal illness was reported, the respondent was asked whether he or she sought medical care, and what treatment, if any, was initiated. All respondents were asked if they had participated in the 6 November banquet and were asked to recall food items consumed. Extra questionnaires were enclosed for accompanying family members who were not included on the official conference participation list. A case was defined as a diarrheal illness in a conference attendee or accompanying family member, with illness lasting 2 or more days and onset occurring from 6 November 1996 to 9 November 1996. Persons with illness not meeting the case definition were excluded from the analysis. All analyses were performed using Epi Info software,[11] version 6.02.

Laboratory investigation

Stool samples were examined for routine enteric pathogens. *Salmonella* isolates were subtyped using standard procedures.

Environmental investigation

Mexican public health authorities were informed of the outbreak and conducted environmental and sanitary inspections. Stool samples of kitchen workers were also obtained.

RESULTS

Epidemiologic investigation

Questionnaires were returned by 81% (232/288) of US attendees, 47% (18/38) of international attendees, and 25 accompanying family members. Eighty-three (30%) respondents had an illness that met the case definition; among respondents, illness was reported by 64 (28%) of US attendees, 9 (50%) of international attendees, and 10 (40%) of accompanying family members. The mean age of persons with illness was 38 years, and 44 (53%) respondents were male. There was no statistical difference in age or gender between the ill and well respondents. Ill persons resided in seven countries. Illness peaked on the morning following the banquet on 7 November 1996 (Figure 1). Signs and symptoms (Table 1) besides diarrhea included weakness (92%), abdominal cramps (83%), myalgia (78%), nausea (71%), headache (71%), fever (60%), vomiting (52%), disorientation (35%), and bloody stools (13%). The median duration of diarrhea was 6 days. Forty-six (53%) respondents sought medical attention for their illnesses, many in Mexico; 17 (37%) of those who sought attention required a second consultation. Several conference participants were too ill to travel until several days after the conclusion of the conference. Two hospitalizations were reported.

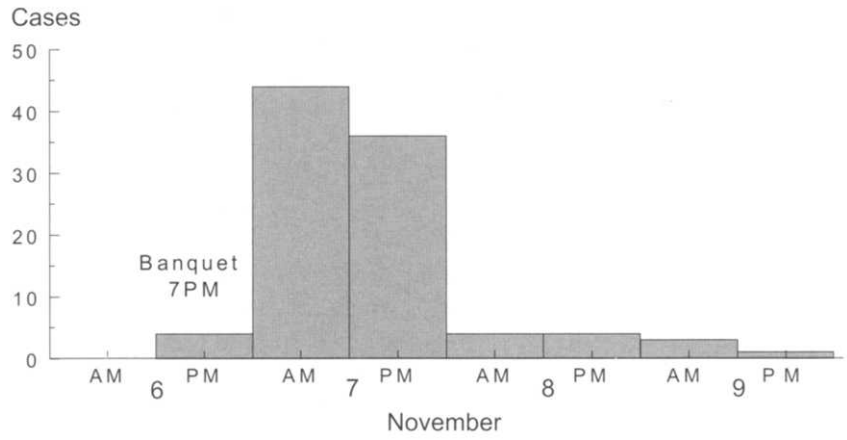

Figure 1. Cases of *Salmonella* serotype Enteritidis infection, by date of illness onset, November 1996; Puerto Vallarta, Mexico.

Attending the hotel banquet on 6 November was significantly associated with illness; 42% (82/194) of banquet attendees became ill versus 3% (1/37) of non-attendees (RR=15.6, 95% CI=2.3–108.9). There were no demographic differences between banquet attendees and non-attendees. Univariate analysis of the food histories identified three food items as being associated with diarrheal illness: chili rellenos, dip sauce, and sponge cake (Table 2). The only banquet food item that remained associated with illness after stratified analysis was chili rellenos; 53% (58/109) of persons who ate chili rellenos became ill versus 22% (12/55) of those who did not (RR=2.4, 95% CI=1.4–4.1). Attack rates among persons who ate chili rellenos differed between the three banquet lines: 10 of 31 (32%) in line 1, 33 of 41 (81%) in line 2, and 9 of 31 (29%) in line 3. The mean incubation period, defined as the time between eating at the banquet and onset of symptoms, was 19 h, with a range of 2–65 h.

Table 1. Occurrence of signs and symptoms of illness associated with a foodborne outbreak of *Salmonella* serotype Enteritidis Phage Type 4 infection, Puerto Vallarta, Mexico, November 1996

Sign/symptom	*Yes (%)*
Diarrhea	83 (100)
Weakness	76 (92)
Abdominal cramps	69 (83)
Myalgia	64 (78)
Headache	59 (71)
Nausea	59 (71)
Fever	50 (60)
Vomiting	42 (52)
Disoriented	29 (35)
Bloody stools	11 (13)
Sore throat	2 (2)

Table 2. Food-specific attack rates for items served during the banquet on 6 November 1996. Univariate analysis of data from 275 respondents; outbreak of *Salmonella* serotype Enteritidis infections in Puerto Vallarta, Mexico

Food Item	*Persons ill[a] who ate (%)*	*Persons ill[a] who did not eat (%)*	*RR*	*95% CI*
Cornfried chips	52/113 (46)	10/36 (28)	1.7	0.9–2.9
Chili con carne	34/72 (47)	24/60 (40)	1.2	0.8–1.7
Chicmolo	54/106 (51)	17/43 (41)	1.3	0.8–1.9
Garmita	43/88 (49)	19/48 (40)	1.2	0.8–1.9
Chili rellenos	58/109 (53)	12/55 (22)	2.4	1.4–4.1[b]
Dip sauce	18/30 (60)	37/112 (33)	1.9	1.2–2.7[b]
Red rice	47/115 (41)	19/43 (44)	0.9	0.6–1.4
Sliced cucumber	17/43 (39)	45/102 (44)	0.9	0.6–1.4
Salad	35/100 (36)	34/67 (51)	0.7	0.5–1.0
Flan	21/48 (44)	43/105 (41)	1.1	0.7–1.6
Rice pudding	17/35 (48)	53/123 (43)	1.1	0.7–1.6
Watermelon	24/50 (47)	46/107 (43)	1.1	0.8–1.6
Sponge cake	30/56 (54)	36/99 (37)	2.1	1.1–2.1[b]
Cheese cake	27/66 (41)	42/95 (44)	0.9	0.6–1.3
Donuts	16/39 (41)	54/126 (43)	0.9	0.6–1.5

[a] Illness is defined as meeting the criteria for a case.
[b] Statistically significant on univariate analysis.

Laboratory investigation

Nineteen case patients submitted stool specimens; the majority of the samples were collected after initiation of antimicrobial therapy. Three stool specimens yielded *Salmonella* serotype Enteritidis (SE), and one stool specimen yielded *Cryptosporidium*. SE was isolated from patients residing in Canada (1), the UK (1), and the USA (1); all SE isolates were phage type 4. The three patients with SE isolated from their stools ate chili rellenos at the 6 November banquet and reported no other common exposures.

Environmental investigation

Local public health authorities identified numerous deficiencies in the hygienic practices of the kitchen staff with regard to storage and processing of food items. All stool isolates obtained from kitchen personnel were negative. Additional information on procedures for making chili rellenos, ingredients and sources of ingredients was obtained, revealing that both eggs and cheese were components of the chili rellenos. A sample of cheese used in the chili rellenos collected on 8 November yielded *Salmonella*; however, the *Salmonella* isolate was discarded and was not available for further subtyping. The cheese was locally produced. Inspection

of the cheese production facility found poor hygienic practices and numerous opportunities for contamination of the cheese.

DISCUSSION

We describe an international outbreak of diarrheal illness among conference attendees, apparently caused by ingredients of chili rellenos served at the 6 November banquet. The incubation period, nature and duration of illness were consistent with *Salmonella* gastroenteritis. The epidemiologic investigation demonstrated that illness was associated with attending the banquet on 6 November. SE phage type 4 was found in the stool samples of ill persons who attended the banquet. We therefore conclude that chili rellenos contaminated with SE were served at the banquet and that they were the source of the outbreak. Although SE was cultured from three ill individuals, many ill persons did not submit a stool sample for culture or submitted a stool sample after taking antibiotics. SE is the likely cause of this outbreak of diarrheal illness. International visitors are usually advised that travelers' diarrhea can be avoided by carefully selecting foods and beverages.[12] Travelers might assume that illness will be avoided by residing in a 'first-class' hotel; however, this outbreak emphasizes that transmission of *Salmonella* may occur even in food served in such establishments.

Salmonellosis is one of the most common foodborne diseases worldwide.[13] *Salmonella* Enteritidis, often associated with eating eggs, is the most common serotype in many countries.[13] In many countries, increases in human *Salmonella* Enteritidis infections have been driven by the emergence of phage type 4.[13] *Salmonella* Enteritidis is present in Mexico and frequently causes foodborne disease outbreaks.[14] A review of 79 foodborne outbreaks between 1980 and 1989 reported to the National Laboratory of Public Health in Mexico revealed the involvement of *Salmonella* Enteritidis in 34% of the 73 outbreaks in which an etiology was determined.[14]

International cooperation was a key feature in the isolation and investigation of *Salmonella* Enteritidis phage type 4 from the stools of three conference attendees in three different countries. The interaction of several health departments was required to identify the outbreak, determine its etiology, and implement control efforts to avoid continuation of the outbreak. Other recent examples of international collaboration in identifying and investigating foodborne outbreaks include *Salmonella* serotype Stanley infections caused by alfalfa sprouts[15] and *Salmonella* serotype Agona caused by a savory snack.[16]

In our modern world, frequent travel as well as importation and exportation of foodstuffs contributes to the globalization of disease and subsequent economic loss. The human illness burden of foodborne diseases in the USA has been estimated to be 76 million infections and 5000 deaths each year.[17] The presence of foodborne pathogens in a food supply not only affects the health of the local population, but also represents a potential for spread of disease to visitors to the country and to consumers in countries that import food products. It is therefore desirable to intensify international cooperation to monitor and prevent foodborne and other outbreaks and consequential economic losses.

Successful examples of such international collaboration are Enter-Net and the cooperative vessel sanitation program. The former is a collaborative surveillance system for laboratory-confirmed infections in Europe,[18] and the cruise-ship industry developed the latter, which has been instrumental in reducing the incidence of cruise-associated diarrheal disease outbreaks.[19] Biannual unannounced inspections of all cruise ships docking in US ports, the publication of assigned sanitation scores, and required reporting of ship's physician visits prior to docking, have resulted in an accurate means of monitoring ship-associated foodborne outbreaks. International cooperation has resulted in the observance of precautionary measures in food preparation aboard vessels, including those of complete cooking of seafood and dishes containing egg products.

The Caribbean Epidemiology Center (CAREC) in cooperation with the Pan American Health Organization (PAHO), the World Health Organization (WHO), and the Ports of Spain and Trinidad and Tobago are developing a hotel-based surveillance system for the prevention of foodborne diseases in the Caribbean hotel industry. The principles of this CAREC/PAHO/WHO proposal could be expanded, and an international surveillance system could incorporate all of the resources currently available among cooperating agencies.

To facilitate *Salmonella* serotyping and thereby promote local investigations and international collaborations in foodborne disease investigations, the WHO, in conjunction with the CDC and the Danish Veterinary Laboratory, started 'Global Salm-Surv', a global *Salmonella* surveillance initiative, in 1999.[20] Global Salm-Surv is a global network of *Salmonella* reference laboratories for the reporting and evaluation of *Salmonella* serotyping and antimicrobial susceptibility results, linked via an Internet E-mailing list. In the near future (anticipated early 2001), serotyping results will be made available on a public web site (www.who.int/salmsurv). It is anticipated that these and other international collaborative efforts will continue to facilitate investigation of international outbreaks that will be necessary for long-term prevention of foodborne disease.

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